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Notes on Modes of Work in the Laboratory of Prof. de Bary in Strassburg, Germany. II. – Having in the last number of the GAZETTE given some statements as to the instrumental outfit of the Laboratory of Prof. de Bary in Strassburg, I desire now to add something as to modes of observation and culture of the lower forms of plant life. Commencing with Fungi, it is safe to say that the first desideratum is to procure living spores, to see mode of germination and trace the subsequent stages so far as practicable. The first question invariably asked me is, in what menstruum are these spores sown? This reply is safe. Try them in simple water first. It will be found that the spores of fungi parasitic upon living plants do well almost invariably in water. until the nourishment has been removed from the spore and reapplied to growth in the germinating tubes of the spores. But when this stage has arrived, a new menstruum must be found, and one as nearly like that of the juice of the plant on which the fungus thrives. For example, a weak solution of well cooked grape sugar would suggest itself for any of the species of fungi which infest the grape vine. In other cases a decoction of bones will produce a vigorous development of the fungus after the water has done its work.

Now how are the spores sown? In very simple contrivances. It appears to be an unfortunate outgrowth of the inventive, mechanical principle so largely characteristic of our race that we ignore simple appliances and run recklessly to complicated machinery for very simple objects. I keep before me as a reminder of supreme folly an elaborate brass growing cell for which I paid five dollars, and then found it was by no means so good as the simple paper "culture-well" used by de Bary and his disciples. This is nothing but a bit of bibulous brown pasteboard one-tenth of an inch thick, and 1.8 inches long by 1.1 inches wide, which has punched (by a gun-wad punch) in the center a hole something more than half an inch in diameter. This first of all must be boiled slightly before using to remove the suspicion of spores that might invalidate results obtained in the cell. This cell is then placed on a glass slide a very little larger, and the spores sown in a hanging drop of water on the under side of the cover glass, but this drop must not touch the paper at any point, lest the whole be drawn off and the cover and spores left dry. In such a cell cultures may be continued for a great length of time; long enough to solve the ordinary life problems for which they are designed. To keep the cell moist and the hanging drop intact and unwasted by evaporation, a little jet of water from time to time thrown on the paper outside the limits of

the cover glass will accomplish the purpose, and this must not be neglected while the object is under observation on the microscope, for it there dries very quickly. Now to keep the slide and its culture-well in good condition, you may have a little brass rack with two upright pieces, say ½ inch wide and three or four inches high for the ends and these connected by horizontal rods, two of which shall form the platform for one set of slides and two more half an inch higher for another set, so you may have several tiers over each other. Then on such a rack you place your slide, put this on a dish with a *little* water, and a bell-glass over all. Inside the bell-glass a bit of thin blotting paper may be placed, which being made moist will aid in keeping the contained air at point of saturation and so prevent drying of spores in cover glass; or, the slide with the culture well and its contained drop and spores, may be left over night on the microscope if desired, to observe one particular spore or point, provided the well is thoroughly moistened and then the bell-glass which covers the microscope provided with the wet blotting paper, just as the bell glass over the rack. So the whole instrument may be placed in a growing cell. Spores may however be sown directly upon a glass slide, without the culture-well, and cared for as those in the culture-well, but it is apparent they are liable to contamination from outside and undesired spores. One great source of error with the beginner in spore culture is, that he sows too many on a slide, and as they grow the whole becomes a confused and tangled mass, which can hardly be said to teach any mycological point with certainty. In this connection the student should read pp. 239 to 242 of Prof. Bessey's admirable text book on Botany, which I am almost tempted to say is the best work of its kind in the English Language. It is a perfect marvel of compact, well considered, biological doctrines, and whatever else a student has he should have this too. Leaf cultures, by which I mean producing a fungal growth on a leaf suspected to contain the spores or the mycelium, is simple enough. One merely needs to place the leaf on sand which has been previously boiled to kill germs, and then allowed to cool. The sand should not be kept wet or the leaf may rot too soon, but a simple dampness maintained. To do this I find a good plan is to place the sand and leaf in an unglazed clay flower pot dish, and this in a larger table plate, then keep an eighth of an inch of water in the latter; it soaks up through the clay dish and sand and moistens the leaf and air satisfactorily. I have now a leaf which three weeks ago gave no sign of perithecia, literally covered with a most promising crop of these or like bodies, and the result brought about by the simple process I have described. Of course over the leaf a tumbler or similar protection must be inverted to prevent evaporation and to keep away stray spores. If the plan proposed makes the sand too damp, simply use less water. To obtain spores from such a leaf, one merely requires to invert a bit of the leaf on a glass slide, then place a drop of water over the spore producing part The moisture imbibed soon causes an expulsion in sufficient numbers to continue the culture. If however one would have a starting point of absolute certainty he must remove an isolated perithecium, gently open it on the glass slide and allow the spores to escape in a drop of water. From this he may reason and observe with some assurance that he is right, and has the product of known spores.

Lichen culture receives a due share of attention. In fact the early researches of de Bary paved the way to the generalizations of Schwendener. Whatever view one may adopt as to the essential nature of lichens, their culture is of great interest. The favorite species for observation is *Endocarpon pusillum*, Hedwig. (*Dermatocarpon Schœreri*, Kœrber). These are collected in the late autumn, and enough of the clay removed with them to keep them alive in healthy condition until required. No water must be given them until they are taken for the cultures, otherwise the spores and small gonidia contained in the apothecia will be prematurely extruded The spores and gonidia are to be sown in a flower-pot dish, on clay which has been thoroughly boiled, and then the surface made smooth as possible, which makes it easier to detect the first sign of the growing lichen. The lichens are then taken along with the surrounding clay, nicely bedded in sand and supports provided on which the edges of the inverted clay containing dish, may rest so that the surface of the moist clay is about one fourth of an inch from the lichen. The lichens are now sprinkled with water and the dish placed in position over them. Spores and gonidia will be extruded in association, and after 24 hours the dish may be removed and put under a bell glass in a light place which is not too damp nor too cold, i. e. temperature something above freezing. While the dish is inverted it should be turned round a little about every half hour to secure a distribution of the spores and gonidia over the surface, and small bits of "cover glass" may be placed here and there on the surface, which being removed will show under the microscope if the spores are escaping properly. The growing spores are handsome objects mounted in glycerine and quite instructive. These may be obtained by placing the glass slip over the lichens as the dish was placed, and afterwards setting it away in a moist place for a few days. It is to be observed that if the dish on which the spores and gonidia are sown be kept too moist and too warm at first, fungi will probably injure the culture. For fuller particulars of the process the reader is referred to Prof. Stahl's Paper, Beitrage zur Entwickelungogeschichte der Fletchen. Heft. II ; ueber die Bedentung der Hymenial gonidien. Leipsic, 1877. Arthur Felix.

Pertusaria is also another favorite group, the gonidia of which are obtained by immersion of the brittle crustaceous mass in water, allowing them to multiply and form zoospores, and then placing them in association with the spores.

A plentiful supply of fresh water Algæ is always on hand. These are kept in glass jars, which stand in the windows and under cover of a bit of glass. Of course the water is frequently changed, and so with little trouble these may be observed in the various stages of growth, throughout the year.

The above hastily written notes will suffice to give an outline as to the modes of culture employed in the celebrated laboratory in Strassburg. Special inquiries demand special adaptations, and these will readily enough suggest themselves to an observer. A noteworthy feature is the extreme care observed by Prof. de Bary in keeping his growing solutions free from foreign spores by boiling and if need be, filtering before using. Boiled or distilled water is used for all ordina-

ry table work in the laboratory, and forceps, needles, and knives used in microscopic manipulation are treated to frequent boiling baths.—J. T. ROTHROCK.

Audibertia Vaseyi, n. sp.—A low, branching shrub; flowering branches stout and rigid, the herbaceous upper portions whitish, cinereous puberulent and viscid-glandular; leaves lance-ovate, acute or obtusish, 1 to 1½ inches long, narrowed into rather slender petioles ¼ to ½ an inch long, crenulate, not manifestly rugose, coated with a close white tomentum; heads of flowers about 6, in virgate spikes, 1 to 2 inches apart, lower ones subtended by a pair of leaf-like bracts; the inner floral bracts lanceolate to linear, setaceously acuminate; broad upper lips of the calyx furnished with a single conspicuous awn, the two teeth of the lower one likewise awned; corollas from ½ to ⅔ of an inch in length, exceeding the bracts; stamens and styles exserted

Mountain Springs, San Diego county, California, June 1880. This plant is No. 500 of a large and fine collection made last summer in lower California by Mr. G. R. Vasey, in whose honor it is named.—THOS. C. PORTER, *Easton, Pa.*

Carnivorous Plants. V.—EXPERIMENT No. XII.—Placed upon a leaf a small fiber of muscle drawn from a piece of boiled beef, at 3 P. M., June 12, '79. The fiber was teased out from the mass of muscles and rolled into a ball having its diameter about 1-12 of an inch.

15 min. no change visible.

30 " a few of the submarginal tentacles had inflected slightly.

45 " the tentacles of last note nearly touched the specimen; a number of the other submarginal tentacles had moved considerably; a few of the marginal tentacles were also inflected.

1 hr. all the submarginal tentacles were more or less inflected and nearly all touched the meat; all but ten of the marginal tentacles were also inflected, varying in degree; the ten were still fully reflexed. To four of these another experiment was applied which will be fully explained in its proper place.

2 hrs. practically there was no change except that six of the ten marginal tentacles mentioned in last note had inflected slightly.

3 " no important change.

15 " all the tentacles were inflected and touched the meat except the four mentioned above which still normally reflexed.

24 " the edges of the leaf still remained normal.

48 " the meat upon the leaf seemed to be enclosed in a semi-transparent fluid containing fat globules as shown by removing a portion by a blunt needle and placing under the microscope. The globules were soluble in ether. The body of the meat itself had assumed a dark brown color. The tentacles and leaf remained the same as the last note.

72 " nothing but an opaque yellowish substance remained upon the leaf.

96 " there was but little change.

120 " the opaque substance upon the leaf had changed into a nearly transparent thickish fluid.

148 " the substance upon the leaf was nearly dry and the marginal tentacles exhibited a tendency to expand.
172 " the marginal tentacles were nearly all reflexed; the other tentacles were more or less reflexed.
195 " tentacles were all reflexed; all that remained of the meat was a dry scale which fell off when the leaf was touched.
212 " there was no further change.
272 " " " " " "
318 " the normal secretion had appeared on the tentacles.*

*In the above experiment an exception seems to appear to the rule that the margin of the leaf becomes more or less incurved according to the substance being digested; that substances easily digested excite the whole leaf and cause a much greater incurvation than those substances which are harder and require more time for digestion and absorption. It seems to me that the following explanation is plausible. Meat when placed upon a leaf seems to excite the marginal and submarginal tentacles to greater activity, causing the glands to pour forth a more copious supply of the viscid secretion. Thus may not the power of the exciting force be spent upon the exterior tentacles and their glands causing a more gradual inflection of the tentacles and less excitement to the leaf as a whole?

Referring to the amount of secretion poured forth by the action of various substances Darwin says:

"It is a remarkable fact that when an object, such as a bit of meat or an insect, is placed on the disc of a leaf, as soon as the surrounding tentacles become considerably inflected, their glands pour forth an increased amount of secretion. I ascertained this by selecting leaves with equal sized drops on the two sides, and by placing bits of meat on one side of the disc; and as soon as the tentacles on this side became much inflected, but before the glands touched the meat, the drops of secretion became larger. This was repeatedly observed, but a record was kept of only thirteen cases, in nine of which increased secretion was plainly observed; the four failures being due either to the leaves being rather torpid, or to the bits of meat being too small to cause much inflection, we must therefore conclude that the central glands, when strongly excited, transmit some influence to the glands of the circumferential tentacles, causing them to secrete more copiously."—[Insectivorous Plants, p. 14.]

The results of all my experiments indicate the truth of the above statement of Dr. Darwin and further that muscular fiber, insects and the like cause usually a more copious supply of secretion and less movement of the margin of the leaf than egg-albumen. The latter although exciting the glands somewhat, as do all nutritious substances, causes more marked incurvation of the margins, varying in degree according to the vigor of the leaf and the amount of substance placed upon it. This will be shown in the tabulated experiments of another series.

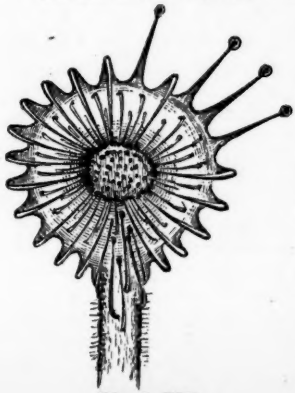

Fig. 2. (3X)

The process of closing in the experiment was so complete and typical that I have caused it to be figured as illustrating the position of the parts when closed (Fig. 2).

The four tentacles that remain reflexed show well the position of the marginal tentacles when there is no substance undergoing digestion. The explanation of a secondary experiment upon this leaf I reserve for special consideration.

The Gymnosporangia or Cedar-Apples of the United States, by W. G. Farlow.—The pamphlet bearing this title consists of thirty eight quarto pages of letter press and two plates, the latter illustrating five United States species of *Gymnosporangium*. It is published by the Boston Society of Natural History in their Anniversary Memoirs and is dated, Boston; 1880.

After giving a brief notice of the different forms of development or alternate generations ascribed to some species of *Puccinia*, and referring to the fact that Œrsted connected the European species of *Ræstelia* with those of *Gymnosporangium* as æcidial forms, the author enters upon the principal or descriptive part of the essay in which he collates and remodels the descriptions (with one exception) of our previously known species of *Gymnosporangium* and *Ræstelia*. With the descriptions are given the American and some of the European synonymy and bibliographical references. Also the principal known localities are recorded, and the references to the authority therefor made. Each description is followed by remarks concerning the habits, appearance, relations and distinctive features of that species. This part of the monograph abounds in the results of the authors observations and investigations and will be interesting not only to the mycological student but also to every lover of botanical science.

Podisoma and *Hamaspora* are not accepted as valid genera, the species sometimes referred to them being all included in *Gymnosporangium*. Of this genus, thus understood, seven species and one variety are described; the form producing globose swellings, on cedar twigs, similiar to those caused by *G. macropus*, being separated from *Podisoma fuscum*, to which it was formerly referred, and described under the name *Gymnosporangium fuscum*, var. *globosum*, Farlow. The familiar names *Gymnosporangium Juniperi*, Lk. and *G. juniperinum*, Fr. are made synonyms of *G. conicum*, DC., although the author expresses some doubt concerning the presence of this species in the United States.

Gymnosporangium speciosum, Pk. which occurs in the western mountain region on *Juniperus occidentalis*, and is described in the BOTANICAL GAZETTE, Vol. IV., p. 217, is omitted, probably through some oversight.

Eight species of *Ræstelia* are described, but here again a doubt is indicated concerning the validity of *R. penicillata*, and a possibility of some error suggested concerning *R. hyalina*. How difficult it is to be fully satisfied in regard to the true characters and limits of species in these fungi may be inferred from the author's remarks under *G. clavipes*, *G. conicum*, and *G. fuscum*, var. *globosum*, as well as from the statement made that "European writers have not agreed among themselves as to the limits of their species." *R. Ellisii*, Pk. is placed as a synonym under *R. botryapites*, Schw., although it is difficult to make it agree with Schweinitz's description of that species. In order to reach the conclusion that the two are the same we must either suppose that the original description of *R. botryapites* is erroneous, or that Schweinitz mistook the gall-like swellings of the leaf for peridia and described them as such. Neither supposition would be very complimentary to the accuracy of Schweinitz; but it may be said, that if we admit the last one to be correct, the characters of *R. Ellisii* will agree passably well with the description of *R. botryapites*.

In the closing pages an account is given of some experimental cultures undertaken with the design of tracing, if possible, the connection between the species of *Gymnosporangium* and *Ræstelia*. Concerning the results of the experiments the author says, "Whether we consider the distribution of our species or the results of the cultures made, there is nothing to confirm the views of Œrsted as to the connection of particular species." In another place he also says, in reference to this subject, "Much more work remains to be done in this country, * * more extended and accurate knowledge of the distribution of our species is to be desired, and many more cultures must be made." "If it should be shown that several of our *Ræstelia* are perennial, a fact true with regard to most of our *Gymnosporangia*, and to grow in regions remote from species of *Juniperus* and *Cupressus*, then one could not help feeling that any connection between the two genera was probably accidental rather than genetic."

It is to be hoped that Prof. Farlow will continue this investigation until the number, identity and distribution of our species shall be satisfactorily ascertained and the supposed connection between the *Gymnosporangia* and *Ræsteliæ* shall be shown to be either real or imaginary. —CHAS. H. PECK.

Maryland Fungi. II.—On the first of August I fled from the tropical heat of Baltimore, but I confess that my flight had more than fresh air for its object. A ramble among the hills and the mountains of Maryland, offered as inducements a more extensive field for collecting, and a further knowledge of the geographical distribution of fungi. In the northwestern counties of this state, I found matters pretty much in the same condition as in Baltimore county. A very intelligent countryman with whom I conversed told me that he had rarely known such a poor season in the way of fungi. Only a few plants were to be met with even in the most favorable localities. But this state of things was not to last long. The third week in August brought a profusion and for three weeks the cryptogamic flora of Maryland was resplendent with beauty. Every lawn, flower garden and woods contributed its full share and the most avaricious collector could feel that his lot had fallen upon fair ground. Wherever I journeyed, "frog stools," so-called, seemed to become quite the fashion; though in some sections it was impossible not to perceive that I was considered "just a little Quixotic," as I heard some one say in a sly way. But for all this I received daily contributions from kind friends who were as might be expected forgetful of classification, and sent pilei without stipes and stipes minus the base. In this way I lost several beautiful Agarics that were new to me and which I never again met with.

At one stopping place I met with three very bright little boys. When I asked them if they knew anything about "frog stools" they replied: "Oh, yes, they knew all about them" I engaged them to come to the hotel the next morning and conduct me to, as they called it, "a grand place for frog-stools." I suppose they wished to assure me of their truthfulness as well as to earn a little money, for they went out early next morning, collected a quantity of fungi, and presented themselves at the door of the hotel saying: "We want to see that frog-stool lady that stays here." Luckily I was in the hall when I heard

the waiter roar out: "You three young scamps clear out this moment! Off with you! Have you gone crazy? Who ever heard tell of a frog-stool lady?" The moment I made my appearance one boy cried out: "There she be!" "That's her!" said another. "Didn't I tell you so!" said the third. The boys exulted over their success, while the waiter fell back looking ashamed of having so unceremoniously driven off my visitors. One boy had his hat filled. Another had an old tin bucket with the bottom half out, but stuffed up with the largest *A. nitidus* I ever saw. The third had a basket without a handle, and wherever there was an opening it was filled up with a large Agaric.

With some few exceptions the plants that I found were the duplicates of those that I had collected in past seasons near Baltimore. *A.* (*Amanita*) *muscarius*, L., with its usual warted and canary yellow pileus, varied in size according to the soil and locality in which it grew. *A.* (*Amanita*) *cæsarius*, Scop., with its smooth viscid pileus and striate margin, varied in intensity of color. At times it was scarlet, then bright sienna red; lamellæ free, yellow; stipe floccose, always more or less curved, and filled with a cottony stuffing; volva adnate at the base with a free margin. *A.* (*Amanita*) *solitarius*, Bull., did not always grow solitary as its name implies, it seemed to love company. I frequently met with three or four plants not more than nine inches apart, and in one instance two grew close together, but this is not the rule. The stipe of this Agaric is always solid, and the flesh is generally dry, but I once met with several plants that exuded a watery juice profusely when cut, and this too in very dry weather when there was no external moisture for them to absorb. *A.* (*Amanita*) *rubescens*, Pers., I found only in one locality with a dark red warted pileus, and stipe covered with red scales. *A.* (*Amanita*) *vaginatus*, Bull., was large and beautiful. *A.* (*Amanita*) *nitidus*, Fr., plentiful and very large.

The scaly cuticled sub-genus *Lepiota* was largely represented. The following species were to be found in quantities nearly everywhere. *A* (*Lepiota*) *Americanus*, Peck, I found in woods near Baltimore in 1879, but it was not to compare with the large and beautiful plants I collected in Carroll and Frederick counties. It varies in depth of color as well as in size. The largest measured 7 inches across the pileus. *A.* (*Lepiota*) *cepæstipes*, Sow., was in every period of its growth and even in its decline, delicately beautiful. I found it mostly in short grass on lawns and in flower gardens, growing in tufts. I remarked its slowness in coming to perfection. I watched a tuft of young plants for two days, and although the atmosphere was warm and damp with occasional gentle showers, they did not expand until the morning of the third day. *A.* (*Lepiota*) *cristatus*, Fr., was plentiful and seemed also to prefer lawns and gardens. *A.* (*Lepiota*) *procerus*, Scop, measured 8 inches across the pileus. This is a variable Agaric in size as well as in color, and the pileus is often without scales. *A.* (*Armillaria*) *melleus*,, Vahl., grew in dense clusters on dead stumps. The pilei varied in size 4–9 inches across; stipes 4–9 inches high. *A.* (*Tricholoma*) *personatus*, Fr., also *A.* (*Tricholoma*) *præfoliatus*, Peck, were large, but not plentiful. *A.* (*Clitocybe*) *illudens*, Schw., was gorgeous. It took possession of old stumps, growing in large bunches, looking like a cloth of gold spread out for some grand entertainment of the Nymphs. The

pilei were 8–10 inches across; stipes 7–11 inches high. *A.* (*Pleurotus*) *ostreatus*, Jacq., grew in large bunches on the projecting roots of an old tree. How it survived the rough usage of the culinary department was a marvel. It grew in front of the kitchen door of a large hotel where hot and cold water were alike poured out. For one week it came successively. The spores were white, .0003× 00020 in. and so plentiful that during the process of drying its surroundings were as white as if flour had been sifted. *A.* (*Pholiota*) *adiposus*, Fr., appeared in large tufts on a *Morus alba* tree. The large bright yellow pilei, most of them 7 inches across, covered with dark brown superficial scales, supported on stipes 5½ inches high, one inch thick, were very beautiful and attractive. It grew not only in dense clusters in the fork of the tree, but aspired to the first branches. On the third of October I met with this Agaric growing luxuriantly in the crevices of the bark and on the branches of a *Morus alba* in an adjacent street. The spores are ferruginous; .00022×.00032 inch. *Cantharellus floccosus*, Schw., was beautifully represented in Carroll county. The largest measured 9½ inches across the pileus, stipe 10 inches high. It grows gregarious and in bunches, several pilei branching from the same stipe.

The beautiful little *Marasmius rotula*, Fr., still has mortuary associations from my finding it growing on dead sticks that had fallen across and around a marble slab that covered the remains of one of the first settlers in Carroll county, a native of Lancashire, England, and a person of some note, who died in 1796, at the good old age of 79 years. In some instances it grew in little tufts, in others it was distributed over the entire length of the sticks, giving them at a short distance the appearance of long spikes of tiny white flowers. Many of the pilei were immature, but those that were perfect measured from one quarter to three quarters of an inch across. The umbilicate plicate pileus with crenate margin; dark red or brown bristle-like stipe, wavy and often branched, combine in making the prettiest little fungus I know *Boletus luridus*, Fr., was large and plentiful also *Boletus modestus*, Peck. *Boletus fellens*, Bull., was small and scarce. I have frequently collected this plant in the woods near Baltimore very large, at times 12 inches across the pileus. Its size depends much upon the soil and the situation in which it grows.

On the Blue Ridge Mountains I found the same species of fungi that I had collected in lower lands as well as in the vicinity of Baltimore. The highest summit of these mountains in Maryland is High Rock. Its top is 1,500 feet above mean tide. Its slopes are inhabited by trees of greater or less size according to the depth of the soil. It was on one of these slopes that I collected the largest number of plants. *Fistulina hepatica*, Fr., about the average size was plentiful on the trunks of oak trees, and on old oak stumps. One could have feasted on this "vegetable beefsteak" had they felt so disposed. *A. orcella*, as I have already stated, grew in large rings, but dwarfed in size. *Cantharellus cibarius*, Fr., also grew in rings, but it was small. *Polyporus nidulans*, Fr., very small, and plentiful on dead sticks. *Lycoperdon gemmatum*, Fr., grew in large clusters, small, about half the usual size. That beautiful little fungus *A.* (*Clitocybe*) *odorus*, Bull., with its bluish-green pileus and sweet spicy odor, growing gregarious or in tufts, occupied a quiet and obscure nook. *Xylaria polymorpha*,

Grev., bristled up on the ruins of an old stump, looking at first sight as if the crumbling pile had even in its decay sent forth a profuse growth of dark brown twigs. Upon near approach, these, at times, variously branched twigs were found covered with white conidia, revealing the secret that they belonged to the Cryptogamic family. Several small specimens of *A. muscarius* assured one that they too could rusticate upon the mountains as well as on the plains. *Lactarius piperatus*, Fr., appeared solitary; it is generally gregarious. It was the first and only *Lactarius* I found during the entire season, and very small. *Russula virescens*, Fr., only two very small plants. In a narrow cleft not very far from the base of the mountain *Scleroderma vulgare*, Fr., was the sole occupant covering spaces three feet in diameter, growing in dense bunches, varying from the size of a walnut to 4–5 inches in diameter. *Lycoperdon pyriforme*, Schæff.. grew singly and in clusters on old stumps and prostrate trunks of trees as well as on the ground; frequently bound together by the rooting fibers. The largest measured 4 inches in diameter, 6 inches high, in shape looking like a large inverted pear.—MARY E. BANNING.

Ferns of Arkansas. II.—

TRIBE BLECHNEÆ.

12. *Woodwardia angustifolia*, Smith.—Occurs plentifully in the swamps of South Ark. Fine specimens are found about Little Rock and Hot Springs.

13. *Woodwardia Virginica*, Smith —Found in the swamps of S. Ark. Noticed in Nuttall's report of the plants of Ark.

TRIBE ASPLENIEÆ.

14. *Asplenium pinnatifidum*, Nutt.—Occurs in N. W. Ark. upon limestone cliffs. *Scarce.*

15. *Asplenium Trichomanes*, L.—Is found in great abundance, and grows large in shaded moist places upon sandstone and limestone cliffs, in the upland portion of Ark.

16. *Asplenium parvulum*, Mart. & Gal.—This interesting species, considered for a long time a variety of *A. ebeneum*, occurs plentifully upon ledges of sand and lime in the N. & W. parts of Ark. It seeks the N. & W. sides of the valleys where it attaches itself to the moss covering the face of the rocks, and seems held in place by it. Dwarfed specimens are frequently found on rocks with S. exposure.

17. *Asplenium ebeneum*, Aiton.—Plentiful in the mountains of Ark. upon rocky hillsides in shaded woods. I have never seen it growing on the escarpments with *A. parvulum.*

18. *Asplenium angustifolium*, Michx.—Occurs sparingly in N. W. Ark. upon rich banks in shaded woods, or upon low cliffs. It may be regarded as rare in Ark.

19. *Asplenium Ruta-muraria*, L.—I have never seen in Ark., but have specimens from Mr. Lesquereux, (Botanist of the Ark. Survey by D. D. Owen) said to have been collected in N. E. Ark. I have never visited the region.

20. *Asplenium Bradleyi*, Eaton.—Found sparingly upon escarpments and roofs of shelving sandstone rocks upon White River, and the ledges of secondary valleys. Also upon isolated ledges inland. One of the rare species of Arkansas.

21. *Asplenium Filix-fœmina*, Bernh.—Is represented in Arkansas by two varieties:

1. var. *angustum*, growing in the sunny and drier places in swamps and along the banks of creeks in woods. Common.

2. var. *commune* is common in wet and shaded places in swamps, and along creeks in shaded woods.

Both varieties are confined to the S. half of the State, or low country.

22. *Camptosorus rhizophyllus*, Link.—Plentiful upon shaded lime and sandstone cliffs in N. W. Ark. Grows luxuriantly, showing well the pilose apex. The auricles at the base are often found rooted, and with secondary fronds. Fronds from 12 to 15 inches long are not uncommon. I have never seen such fine specimens anywhere.

TRIBE ASPIDIEÆ.

23. *Phegopteris hexagonoptera*, Fee.—Abundant upon dry hills and in low ground throughout N. and W. Ark.

24. *Aspidium Noveboracense*, Swartz—Occurs in the swamps about Hot Springs, and probably throughout S. Arkansas.

25. *Aspidium Thelypteris*, Swartz.—Plentiful in bogs about springs in N. W. Arkansas.

26. *Aspidium cristatum*, Swartz.—Occurs in S. E. Arkansas. We have specimens from near Pine Bluff found growing in swamps by Mr. G. E. Lytle.

27. *Aspidium spinulosum*, Swartz.—Said to grow in rich woods by the Botanist of the Ark. Survey. I have not found any specimens.

28. *Aspidium acrostichoides*, Swartz.—Plentiful in the elevated regions of the State. Found upon the base of shaded cliffs, and on rich alluvial banks in moist situations, also in the swamps of S. Ark.

29. *Aspidium marginale*, Swartz.—Quite common upon shaded moist cliffs in the mountains of Ark. Grows very large. Inland and along streams.

30. *Cystopteris fragilis*, Bernh.—Occurs in N. W. Ark. upon shaded moist cliffs and rich banks. Seems to prefer sandstone.

31. *Cystopteris bulbifera*, Bernh.—Quite plentiful on shaded rocks in the mountains. Specimens from N. W. Ark. are sometimes nearly two feet long. Found on both lime and sandstone.

32. *Onoclea sensibilis*, L.—Occurs in spring bogs and upon low wet cliffs of White River with a North exposure. The form growing on rocks differs from the low ground form in having the sterile frond ovate in outline, the pinnæ oblong, obtuse and entire, the stipe no longer than the blade.

TRIBE WOODSIEÆ.

33. *Woodsia obtusa*, Torrey.—Upon cliffs and in rocky woods. Prefers moist shaded places, though found in dry situations. Inland and along streams. Grows luxuriantly.

TRIBE DICKSONIEÆ.

(Not Represented.)

SUBORDER CERATOPTERIDEÆ.

" HYMENOPHYLLACEÆ.

" SCHIZÆACEÆ.

(Not Represented.)

SUBORDER OSMUNDACEÆ.

34. *Osmunda regalis*, L.—Common in the swamps of Arkansas.

Growing with No. 35. Found as far North as the line of the Ft. Smith and Little Rock R. R.

35. *Osmunda cinnamomea*, L.—Swamps of South Arkansas, also on cliffs of sandstone in the extreme N. W. part of the State upon White River.

ORDER OPHIOGLOSSACEÆ.

36. *Botrychium ternatum*, Swartz, var. *lunarioides*, Milde.—Said to occur in the rich woods of Ark. We have not found it.

37. *Botrychium ternatum*, Swartz, var. *obliquum*, Milde.—Occurs in the low rich woods of S. W. Ark. The Arkansas form has rather broad sterile fronds. We have specimens from S. W. Ark. collected by Miss Mary Jones, of Montgomery Co.

38. *Botrychium Virginicum*, Swartz.—Common in the rich shaded copses of the upland portion of Ark.

39. *Ophioglossum vulgatum*, L.—In N. W. Arkansas upon limestone ledges 200 ft. above the valleys, also wet woods in rich soil.

Some Arkansas Trees.—Mr. Warder will find in the August and September numbers of the GAZETTE for 1880 an account of some specimens of *Castanea pumila* occuring in Hempstead County, which exceed in size those he found near Hot Springs. Specimens two feet in diameter are found in N. W. Ark., near Fayetteville. I am informed that a few specimens of *C. vesca* occur in E. Ark., but whether they are introduced or spontaneous I am unable to decide having never seen the specimens growing. I should like to know more about the occurrence of *Pinus australis* in Ark. I did not find it while in S. Ark. last summer, but *P. mitis* extends as far South as the Texan border. Should also like to know whether *Magnolia grandiflora* grows spontaneously about Malvern.

M. macrophylla and *tripetala* are common in Garland and adjoining counties, but I did not find *M. grandiflora* spontaneous. *Ilex opaca* grows much farther N. in Ark. than Malvern. It is common about Hot Springs.

I have passed from the N. to the S. part of Ark. in order to observe the change of tree covering, and find that it is governed by altitude, moisture, soil and other physical conditions, and that one can pass from one geological horizon to another and not be aware of it by a change in vegetation.

It is true that *Q. aquatica* and *Phellos* are not found in the N. part of the State, but they extend on the sub-carboniferous as far as the mountains about Ft. Smith, the distribution being termed by the physical rather than geological conditions. The same may be said of *Ilex opaca* and other species.

One could go from Malvern through Magnet Cove to Hot Springs and from the vegetation never dream he was passing across such a remarkable metamorphic region.

Q. Phellos and *aquatica* might be added to the Oaks of Garland Co., as they grow about Hot Springs.

This is not written in the spirit of criticism, but that I may know more about some species spoken of by Mr. Warder in March GAZETTE, p. 188.—F. L. HARVEY, *Ark. Ind. Univ., Fayetteville, Ark.*